Pre-Conference Activities

Article: Hamming It Up on the ISS

You see it on television: NASA officials contact astronauts on the Space Station through radio hookups. There's another way to keep in touch with crewmembers, though, and anyone with a ham radio system can participate. And just for the record, the conversations don't start with "Breaker, breaker one-nine."

Amateur radio, also called ham radio, has become the fun way for average folks to communicate with Space Shuttle and Space Station astronauts. Anyone with a scanner can listen to the communications that take place between Earth and space, and if you have a transmitter, you can get in on the conversations.

"The whole point is to spark an interest in science and technology," says Frank Bauer, chief of the Guidance and Navigation Control Center at Goddard Space Flight Center in Maryland. "Communicating with ham radio started with the Space Shuttle program in 1983, and by the mid 80s, we had several school group interaction activities going."

"This opens new doors for access to the astronauts," Bauer says. "Before, only the president or other VIPs could talk with the astronauts while they were in space. Now with an amateur radio license, you can talk too. The ham radio project was the first effort to allow astronauts to talk with the general public."

To talk with the astronauts, you'll need to know several important bits of information, says Paul Dumbacher, a propulsion test engineer at Marshall Space Flight Center in Alabama, who also enjoys ham radio. Everything you'll need to know to get started is listed at the Amateur Radio on the International Space Station (ARISS) web site (http://ariss.gsfc.nasa.gov/).

"The important things to know are when the Space Station will be over your location, what frequency the astronauts transmit on, and what the crew's schedule is," Dumbacher says. "It doesn't matter if ISS is passing overhead during daylight hours, because you don't need to see the craft. The important thing is to take advantage of the small window of opportunity you have to communicate with them. ISS is overhead for only about 10 minutes at a time in any given area, so you have to be on the ball."

Information at the ARISS web site will tell you the call signs of the astronauts, so you'll know whom you're listening to, Dumbacher says. And taking the time to learn a bit of basic amateur radio lingo will help you understand the proceedings.

"Conversations begin with the sender's call signs and then a signal report," Dumbacher says. "Then someone is asked what their QTH is; that's short for your location. If an astronaut says, "QRZ," that means he's opening the conversation up for the next interested participant. It takes a while to learn the language of ham radio, but it's a wonderful opportunity to make contact with a piece of history. You can see NASA on TV, look at maps,

and they don't seem real. But to go outside and look up and see the Space Station or hear them talking on the radio. That's real. To talk with people on a man-made object launched by a rocket is all very amazing."

While individuals can monitor Space Station transmissions from home, school groups can make it a class project and work closely with ham radio operators and NASA staff members to schedule a conversation with the astronauts. The ARISS project was started with that goal in mind: classes of students interacting directly with astronauts through ham radio linkups.

"There are many options open to contacting the astronauts through amateur radio," Bauer says. "Sometimes schools can't contact the ISS from their location. They can use a program called Tele-bridge, which is a phone bridge set up to communicate from telephone to short wave radio. We've had groups in Australia and South Africa use Tele-bridge to make their connections."

It's a challenge to be sure the school group is ready to communicate at the precise moment the Space Station is overhead, Bauer says. "There's a 10-minute window you have to jump on. The equipment can't be too simple or too complex, you have to have the orbit information right, and the children have to be prepared to conduct their conversations efficiently. But it's all worth it when it works."

The actual contact with the astronauts is the top of the pyramid, Bauer says. It's the peak experience. "But the foundation under that pyramid peak is the remarkable part. The learning required to prepare for this contact-antenna, radio, orbit, press releases, geography, trail and error-it all shows the children how demanding this process is, and how much knowledge is required for success."

It's a living example of why mathematics and science are good things. "It shows practical use of formulas," Dumbacher says. "Students learn about complex ideas like Doppler Shift and trajectory paths. It shows that even addition and subtraction get you to important points. Science matters; without science we wouldn't have ISS; we wouldn't understand weather; we wouldn't understand basic functions of everyday life. And there's no better way to learn it than by doing it."

If you get the opportunity to make contact with Shuttle or Space Station astronauts, Dumbacher has one bit of advice. "Be sure to get a QSL card. That's a card NASA will send you proving that you talked to an astronaut. There's information about getting it on the ARISS web site. You'll want to be able to put that up on your bulletin board and tell everyone."

Courtesy of NASA's Space Operations Mission Directorate

Speaking Radioeese

Teacher Sheet(s)

Objective: State oral directions clearly and correctly. Construct a structure using oral directions.

Level: 5-8
Subjects(s): Science, Mathematics
Prep Time: Less than 10 minutes
Duration: 30 - 45 minutes
Materials Category: General Classroom

National Education Standards
Science: Science as Inquiry, Technology, History and Nature of Science
Math: 4a, 9a, 8a 18, 20

Materials:

- Pattern blocks (or any type of building blocks)
- One manila folder (or hard bound book)
- Two popsicle sticks or tongue depressors, or two cardboard centers from paper towel rolls
- Aluminum foil pieces
- Books or short stories about space (one for each group)
- Optional: 2.5 cm Styrofoam ball for top of microphone

Pre-Lesson Instructions:
None

Background Information:
Communication is an important, vital, and necessary part of all space flights. The members of each Shuttle and International Space Station crew must talk with each other and with workers on the ground to carry out the many functions needed to fly the spacecraft and rendezvous with other objects in space. Mission Control must keep in constant contact with other personnel at sites around the world to monitor the progress of the spacecraft as it orbits Earth. Teachers and students in schools communicate with each other to learn more about space travel and how it is changing our lives each and every day. The astronauts use a radio on board the Shuttle on frequencies used by amateur (or "ham") radio operators to communicate directly with large groups of students. For all operations, Earth stations listen to the input or receiving frequency and transmit only when the Shuttle is in range of the ground station and the astronauts are using the radio. Students listen for any instructions from the astronauts as to the output or transmitting frequency before transmitting to avoid interfering with other radio users. They practice using a

microphone correctly just as the astronauts must do during their training for the mission.

Guidelines:

1. Read the article "Hamming It Up On ISS."

2. When students, astronauts, and ham radio operators use the amateur radio to talk with people next door, all over the world, or orbiting in space, they use a microphone. Explain to students that they are going to make a "pretend" microphone that will be used when practicing how to talk correctly over the radio. Give each student one popsicle stick, tongue depressor, or cardboard center from a paper roll, and a large piece of aluminum foil. Demonstrate how to wrap the foil around the top of the stick in a ball so it looks like the top of a microphone. A 2.5 cm Styrofoam ball may be placed on top of the stick and covered with one layer of foil instead.
3. Model for students how to hold the microphone in one hand, not too close to the mouth. Say the names of the nine planets to demonstrate how to speak slowly and distinctly. Be sure to tell the students each time they have finished speaking that they are to say "over." This is the word used by amateur radio operators to signify they have finished their transmission and others may now talk. Allow time for students to make a microphone and to practice speaking with their teammates. Circulate among the students and make sure they are holding the microphone correctly and speaking correctly. Have one student say the nine planets, stopping wherever they wish and saying, "over." The teammate must begin speaking into the microphone saying the next planet, and when finished, saying, "over."

Example: "Mercury, over." "Venus, Earth, Mars, over." "Jupiter, Saturn, over."

After the initial practice time, tell students they are going to read to their teammates. Each student in the team will read a paragraph or page from a book or story while holding the microphone correctly. Each time they have finished reading, they must say, "over" before the next person can begin. Teammates are not to begin until they hear the word "over."

When the class has had sufficient practice time, have them put down the microphones and show them the pattern blocks. Ask students to tell you what they know about each shape. Have students draw each shape or write the names of each block on the Student Sheet as you display them to the class (square, triangle, two parallelograms, hexagon, trapezoid, etc.).

HINT: For older students, use one block of each shape. For younger students, pick only two or three.

Explain to students that when astronauts are in space, they talk to the ground through a Capsule Communicator (CAPCOM). This is another astronaut located in the Mission Control Center (MCC) at Johnson Space Center (JSC) in Houston. All

information and directions are relayed to the astronauts on orbit through the CAPCOM.

4. Tell students that one member of each team will be taking the role of astronaut and the other member will be CAPCOM. Show students the blocks you are going to use and ask them to get those blocks from their piles.

5. Model the activity by taking the role of CAPCOM and having all students become astronauts. Build a structure behind a manila folder so students cannot see the structure. Make sure students understand spatial perspective and orientation of left and right.

   After you have built a structure, use your microphone to give detailed instructions so the students will be able to replicate what you have built. Remember to say "over" after each set of instructions.

6. After the students have completed building, compare the structures. Discuss which words you used that were helpful to them in building. Have students make a list of these words on the Student Sheet.

7. Students will now be given time to build with their partners. They will build many times, switching roles each time, and using the microphone each time. Circulate among the class to monitor and assist.

8. When building has been accomplished many times, have students write directions on the Student Sheets. These sheets can be taken up for assessments. They can also be used as written instructions for other students to build structures.

Discussion/Wrap-up:
Discuss the importance communication played in building the structure. How would this be important in space flight? How will this be important in building the International Space Station?

Extensions:

- Have students use two-way radios. Each student should be in a different room or location. Build the structures by communicating the directions correctly over the radio.
- Have students write their own scripts for a play describing a problem on the Shuttle or International Space Station. The problem would necessitate the building or repairing of some piece of equipment used by astronauts during a mission. Students could perform the play. If video equipment is available, students could set up their own production as a newscast and show the production to other classes.
- Have students use the microphones each time they talk for an entire day.

Speaking Radioeese

Student Sheet(s)

Name: _____

Names / Shapes of Pattern Blocks

Directions for building my structure:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
Communications are important in space flight because: